IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: :

    Christopher Evans   :

Application. No.: TBD   :   Group Art Unit: TBD

                                               :

Filed: September 30, 2003   :   Examiner: TBD

Title: SQL PREDICATE MIGRATION

CLAIM FOR PRIORITY

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

A certified copy of corresponding Great Britain Application No. 0309971.0, filed April 30, 2003 is attached. It is requested that the right of priority provided by 35 U.S.C. 119 be extended by the U.S. Patent and Trademark Office.

Respectfully submitted,

Date: September 30, 2003

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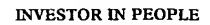
I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation and Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein together with the Statement of inventorship and of right to grant of a Patent (Form 7/77), which was subsequently filed.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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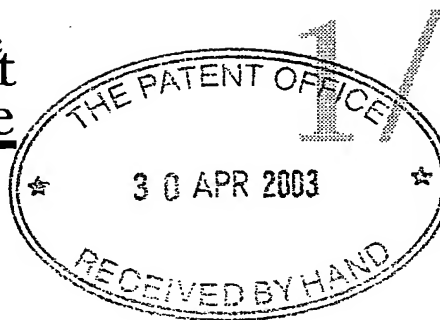
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Dated   30 June 2003

Patents Form 1/77

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Request for grant of a patent

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The Patent Office

Cardiff Road
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1.	Your reference	RSJ07765GB

01MAY03 EB04037-12 D02890

P01/7700 0.00-0309971.0

2.	Patent application number *(The Patent Office will fill in this part)*	0309971.0

3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*

Oracle International Corporation
500 Oracle Parkway
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California 94065
USA

3 0 APR 2003

837301001

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

DELAWARE, USA

4.	Title of the invention	SQL Predicate Migration

5.	Name of your agent *(if you have one)*	Gill Jennings & Every

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Broadgate House
7 Eldon Street
London
EC2M 7LH

Patents ADP number *(if you know it)*   745002

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day / month / year)*

8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	YES

Patents Form 1/77

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9. Enter the number of sheets for any of the
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   Continuation sheets of this form

   Description   5

   Claim *(s)*   1

   Abstract   –

   Drawing *(s)*   1 + 1

10. If you are also filing any of the following,
    state how many against each item.

    Priority documents

    Translations of priority documents

    Statement of inventorship and right
    to grant of a patent *(Patents Form 7/77)*

    Request for preliminary examination
    and search *(Patents Form 9/77)*   1

    Request for substantive examination
    (Patents Form 10/77)   1

    Any other documents
    (please specify)   NO

11. For the applicant Gill Jennings & Every	I/We request the grant of a patent on the basis of this application. Signature _Michael Lord_ Date 30/04/03
12. Name and daytime telephone number of person to contact in the United Kingdom	R.E. SKONE JAMES 020 7377 1377

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Statement f inventorship and f right to grant of a patent

The Patent Office
Cardiff Road
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NP9 1RH

1.	Your reference	RSJ07765GB
2.	Patent application number *(if you know it)*	0309971.0
3.	Full name of the or of each applicant	Oracle International Corporation
4.	Title of the invention	SQL PREDICATE MIGRATION
5.	State how the applicant *(s)* derived the right from the inventor *(s)* to be granted a patent	By employment.
6.	How many, if any, additional Patents Forms 7/77 are attached to this form? *(see note (c))*	

7. For the applicant
Gill Jennings & Every

I/We believe that the person *(s)* named over the page *(and on any extra copies of this form)* is/are the inventor *(s)* of the invention which the above patent application relates to.

Signature   Date

                                             20 May 2003

8.	Name and daytime telephone number of person to contact in the United Kingdom	SKONE JAMES, Robert Edmund
		020 7377 1377

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

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Patents Form 7/77

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

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Reminder

Have you signed the form?

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

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Reminder

Have you signed the form?

SQL PREDICATE MIGRATION

This invention relates to a method of preventing unnecessary joins between tables in a database from being
5 executed and, in particular, to a method for automatically rewriting SQL statements to achieve this.

The concept of a join between tables in a database is well known. A simple example will be described here with reference to Figure 1. This shows two tables with the
10 names EMP and DEPT. The first table EMP lists the names of the employees of a company under the column ENAME and the number of the department for which they work under the column DEPTNO. The table DEPT has a similar column named DEPTNO in which each department number is only listed once
15 and adjacent to this is a column entitled DNAME giving the names of the respective departments. It can be seen that a many to one relationship exists between the tables EMP and DEPT via their respective DEPTNO columns. That is to say that each value appears only once under the DEPTNO
20 column of DEPT but can appear many times under the corresponding column of EMP. In this context, table EMP is referred to as the detail table and table DEPT is referred to as the master table.

In the table DEPT, the column DEPTNO has values that
25 are unique in each row and this column is referred to as the primary key of the table. This primary key is typically indexed allowing fast access to each row. In table EMP, the column DEPTNO is referred to as the foreign key. This is not necessarily an indexed column although
30 typically it is.

If it were desired to extract the names of the employees and their respective department names, then typically, a view would be defined as follows:

35   SELECT ENAME, DNAME FROM EMP, DEPT
    WHERE EMP.DEPTNO = DEPT.DEPTNO

This view may be known as EMPDEPT.   Then, an SQL statement may refer to this view EMPDEPT such as:

SELECT ENAME, DNAME FROM EMPDEPT

This statement requires the join to be executed in order to extract the required data from both tables. However, there are instances in which it is not necessary to execute the join in order to extract the required data but nevertheless, the database still executes the join. Clearly, it is desirable to provide a method in which this unnecessary execution of joins can be prevented.

In accordance with a first aspect of the present invention, there is provided a method of rewriting a Structured Query Language (SQL) statement in order to prevent processing of a join between a master table and a detail table in a database, the join having a join condition, the method comprising the steps of:

a. determining in the SQL statement a unique identifier to a row of the master table;

b. equating the unique identifier to an identifier to related rows of the detail table using the join condition;

c. producing a revised SQL statement that only refers to the detail table using the identifier to the at least one row of the detail table; and,

d. processing the revised SQL statement.

Hence, the invention provides a method for rewriting SQL statements which refer to two tables such that the correct data can be retrieved without executing the join if that data is contained in only one of the tables.

The unique identifier to a row of the master table may be indexed.   In this case, the unique identifier to a row of the master table may be a primary key.

The identifier to at least one row of the detailed table may be a foreign key.

Typically, the join condition is an equality between a column of the master table and a column of the detail table.

The invention will typically be provided as a computer program comprising computer program code means adapted to perform the steps of the first aspect of the invention when said program is run on a computer.

Further, there may be provided a computer program product comprising program code means stored on a computer readable medium for performing a method according to the first aspect of the invention when said program product is run on a computer.

An embodiment of the invention will now be described with reference to the accompanying drawing, Figure 1, which shows two tables in a database.

The embodiment of the invention is best described with reference to an example SQL statement, such as:

```
SELECT ENAME FROM EMPDEPT
WHERE DNAME = "R&D"
```

This refers to the view EMPDEPT defined as:

```
SELECT ENAME, DNAME, DEPT.DEPTNO FROM EMP, DEPT
WHERE EMP.DEPTNO = DEPT.DEPTNO
```

Since the SQL statement refers to both of the tables shown in Figure 1, the join between them, as defined in view EMPDEPT, will be executed by the database and there is an attendant cost in processing speed due to this. However, with this SQL statement it is not, in fact, necessary to execute the join if the statement is rewritten in advance. The method of the invention performs this automatically.

The SQL statement may be either entered manually or using a graphical user interface but, in this example, we will assume that it is being entered manually.

The first step in the method is to determine in the SQL statement a unique identifier to a row of the master table. In this instance, the master table is DEPT and table EMP is the detailed table.

5   In this case, since the SQL statement is attempting to retrieve the data and the column ENAME in table EMP only where the corresponding DNAME value equals "R&D" then the SQL statement can be rewritten to refer to the primary key of table DEPT as follows:

10

SELECT ENAME FROM EMPDEPT WHERE DEPTNO = 10

In fact, this change will normally speed up the processing of the SQL statement since the primary key is

15   typically indexed thereby allowing fast access to the rows of the table via column DEPTNO.

This SQL statement can then be combined with the definition of the view EMPDEPT to produce an SQL statement as shown:

20

SELECT ENAME FROM EMP, DEPT
WHERE EMP.DEPTNO = DEPT.DEPTNO
AND DEPT.DEPTNO = 10

25   The next step in the method is to equate the unique identifier to a row of the master table to an identifier to related rows of the detail table using the join condition. In this case, the join condition is that EMP.DEPTNO = DEPT.DEPTNO and so the above SQL statement can

30   be reduced to:

SELECT ENAME FROM EMP WHERE EMP.DEPTNO = 10

As can be seen, this new statement only refers to the

35   detailed table, the join being eliminated and instead of filtering the results using a value from the DEPT table, the predicate has been migrated using the join condition to

the equivalent predicate related to the EMP table. As a result, the new SQL statement no longer refers to the DEPT table.

This new SQL statement can then be processed by the
5   database and will be executed more quickly than the original SQL statement due to elimination of the join.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill
10   in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of a particular type of signal bearing
15   media actually used to carry out distribution. Examples of computer readable media include recordable type media, such as floppy disks, a hard disk drive, RAM and CD-ROMs as well as transmission-type media such as digital and analogue communications links.

20

CLAIMS

1. A method of rewriting a Structure Query Language (SQL) statement in order to prevent processing of a join between a master table and a detail table in a database, the join having a join condition, the method comprising the steps of:

    a.   determining in the SQL statement a unique identifier to a row of the master table;

    b.   equating the unique identifier to an identifier to related rows of the detail table using the join condition;

    c.   producing a revised SQL statement that only refers to the detail table using the identifier to the at least one row of the detail table; and,

    d.   processing the revised SQL statement.

2. A method according to claim 1, wherein the unique identifier to a row of the master table is indexed.

3. A method according to claim 2, wherein the unique identifier to a row of the master table is a primary key.

4. A method according to any of the preceding claims, wherein the identifier to at least one row of the detail table is a foreign key.

5. A method according to any of the preceding claims, wherein the join condition is an equality between a column of the master table and a column of the detail table.

6. A computer program comprising computer program code means adapted to perform the steps of any of the preceding claims when said program is run on a computer.

7. A computer program product comprising program code means stored on a computer readable medium for performing the method of any of claims 1 to 5 when said program is run on a computer.

8. A method substantially as hereinbefore described with reference to the accompanying drawings.

EMP

ENAME	DEPTNO
CHRIS	10
STEVE	10
PAUL	20
JOHN	30

DEPT

DEPTNO	DNAME
10	R & D
20	SALES
30	ACCOUNTS

Figure 1